DPS 4000 Series
CAN bus pressure transducer
User manual - K296

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CE

This product complies with the requirements of the relevant EC Directives. For data on the applied standards, refer to the “Declaration of Conformity”.

Safety

To use this pressure transducer safely, you must use the data and procedures in this publication. Use the pressure transducer only for the specified applications (refer to section 1).

The warnings and cautions in this publication are as follows:

WARNING

- **Do not interchange transducers between an oil system and a system that uses fuel or gas. This can cause an explosion that can cause death or injury, and/or damage to equipment.**
- **High pressures and temperatures are dangerous (refer to the pressure limits in table 2-2). Be careful when you do work on components connected to lines that have high pressures and heat. Use the applicable protection and obey all safety precautions.**
- **Be careful when you do work on components with connections to an electrical supply. When possible, do the work with the electrical supply disconnected. Electrical shocks can cause death or injury.**

CAUTION

- **Until you are prepared to install the unit, keep it in the original container with all the covers in position. The container and covers prevent contamination and damage. When not in use, keep the connections clean at all times, and put covers on the open connections.**
- **Do not use high-pressure gas to remove dirt from the unit. This can damage the sensor in the unit.**

Before you start an operation or procedure in this publication, make sure that you have the necessary skills (if necessary, with qualifications from an approved training establishment). Follow good engineering practice at all times.

Dangerous materials

There are no known dangerous materials used in this pressure transducer.

Repair and maintenance

Follow all the recommended maintenance procedures (refer to section 5). If it is necessary to repair the unit or change the software, contact an approved service agent (refer to section 5).

Technical support

For technical support, contact either the manufacturer or an approved service agent (refer to section 5).

References

For more data, refer to these publications:

1. CANopen Application Layer and Communication Profile - CiA Draft Standard DS-301 (Version 4.01)
2. CANopen Device Profile for Measurement Devices and Closed Loop Controllers - CiA Draft Standard Proposal DSP-404 (Version 1.0)
3. CANopen Layer Setting Services and Protocol (LSS) - CiA Draft Standard Proposal DSP-305 (Version 1.0)
4. CANopen Representation of SI Units and Prefixes - CiA Draft Recommendation DRP-303-2 (Version 1.1)

Abbreviations

The abbreviations in this publication are as follows:

a	Absolute (Pressure version)
ADC	Analogue-to-Digital Converter
A/F	Across the Flats (Dimension data)
AP	Applied Pressure
ASCII	American Standard Code for Information Interchange
°C	Celsius (Degrees)
CAN	Controller Area Network
CANopen	A set of standards that defines the operation of devices across a CAN system.

CiA	CAN in Automation international users and manufacturers group (CiA e.V.)
COB	Communication Object (CAN Message): Data is sent across a CAN Network inside a COB.
COB-ID	COB-Identifier. Identifies a COB uniquely in a Network and determines the priority of the COB.
d	Differential (Pressure version)
DC	Direct Current
DPS	Digital Pressure Sensor
EEC	European Economic Community
EMC	Electromagnetic Compatibility
EN	European Norm
°F	Fahrenheit (Degrees)
FP	Floating Point
FS	Full-scale. Refers to a full-scale value from a transducer or instrument.
FV	Field Value
g	Acceleration of Gravity
g	Gauge (Pressure version)
g	Gram
Hz	Hertz
ID	Identifier
kbits/s	Kilobits per second
LSS	Layer Setting Services (refer to *References*)
Max	Maximum
mbar	Millibar
MIL-STD	Military Standard
Min	Minimum
mm	Millimetre

ms	Millisecond
MΩ	Megohm
NMT	Network Management: One of the service elements of the CAN Application Layer
NPT	National Pipe Taper (a thread standard)
PDO	Process Data Object
PIN	Personal Identification Number
psi	Pound-force per square inch
PV	Process Value
SDO	Service Data Object
SI	Système International
S/N	Serial Number
Tx	Transmit
UNF	Unified Fine (a thread standard)
VDC or Vdc	Volts Direct Current

Table of Contents

Safety iii
Dangerous materials iii
Repair and maintenance iv
Technical support iv
References iv
Abbreviations iv
Table of Contents vii
1. Introduction 1-1
Applications 1-2
Summary of facilities 1-2
Summary of the CANopen set of functions 1-3
The pressure transducer you receive 1-3
2. Technical data 2-1
Physical data 2-1
Dimensions 2-1
Weight 2-2
Compatible pressure media 2-2
Physical connections 2-2
Performance data 2-3
Pressure performance 2-3
Temperature performance 2-4
Accuracy – Pressure and temperature measurements 2-4
Long-term stability 2-4
Electrical data 2-5
Environmental data 2-5
Pressure Equipment Directive 2-5
Electromagnetic Compatibility (EMC) 2-5
Effects of vibration and shock 2-5
3. Installation data 3-1
Installation – An example CAN bus system 3-1
Installation – Before you start 3-2

Installation – Procedures 3-2
Pressure connections – Gauge or Absolute 3-3
Pressure connections (+ and -) – Differential 3-3
Electrical connections 3-3
To complete the installation 3-4
4. Operation 4-1
Operation – The primary components 4-1
Operation – Before you start 4-1
Operation – Procedures to get started 4-2
To change the operation – Node ID and Baud rate 4-2
To change the operation – Objects: 0x1000 – 0x1FFFF 4-3
0x100C to 0x100E – Error control: Node Guarding option 4-3
0x1017 – Error control: Heartbeat option 4-3
0x1011 01 – To reapply the factory values 4-3
0x1800 02 – The PDO transmission (Type or period) 4-3
0x1A00 – The data in the 'Transmit PDO' 4-4
To change the operation – Objects: 0x2000 – 0x2FFFF 4-4
0x210A/0x210B – The rate of new data 4-4
0x2200 – To change the calibration data 4-5
0x2201 to 0x2203 – The last calibration year, month, day 4-5
0x2204 to 0x2206 – The next calibration year, month, day 4-5
0x2207 – The pressure calibration gain 4-5
0x2208 – The pressure calibration offset 4-6
0x2209 – The temperature calibration gain 4-6
0x220A – The temperature calibration offset 4-6
0x2304 – The tag for the type of data 4-6
To change the operation – Objects: 0x6000 – 0x6FFFF 4-7
0x6120 to 0x6124 – The scale data for the pressure output 4-7
0x6131 01 – The units for the pressure output 4-7
0x6148 – The local limits (minimum pressure and temperature) 4-8
0x6149 – The local limits (maximum pressure and temperature) 4-8
To monitor the operation – Objects: 0x1000 – 0x1FFFF 4-8
0x1001 – The status of the unit 4-8

To monitor the operation – Objects: 0x2000 – 0x2FFFF 4-8
0x2006 – The count: Pressure is more than the limit 4-8
0x2007 – The count: Pressure is less than the limit 4-9
0x2008 – The count: Temperature is more than the limit 4-9
0x2009 – The count: Temperature is less than the limit 4-10
To monitor the operation – Objects: 0x6000 – 0x6FFFF 4-10
0x6130 01/0x6130 02 – The pressure and temperature 4-10
0x6150 – The pressure and temperature status 4-10

5. Maintenance 5-1

Maintenance – From the software 5-2
The status of the unit 5-2
Maintenance – Cleaning 5-2
Maintenance – Calibration 5-3
Calibration – The equipment you need 5-3
Two-point pressure calibration – Procedure 5-3
Two-point pressure calibration – Results 5-5
Approved Service Agents 5-6

Appendix A A-1

DPS 4000 Series – CANopen Object Dictionary A-1

0x1000 / 0x1017 ..... A-2
0x1018 / 0x1A00 ..... A-4
0x2003 / 0x2206 ..... A-6
0x2207 / 0x2304 ..... A-8
0x6100 / 0x6122 ..... A-10
0x6123 / 0x6131 ..... A-12
0x6148 / 0x6150 ..... A-14

Appendix B B-1

Data for the alternative pressure units B-1

1. Introduction

The pressure transducers in the DPS 4000 series supply fast, accurate pressure data through a Controller Area Network (CAN) bus interface. These are the types of pressure transducer that are available:

- Gauge
- Absolute
- Differential

All the pressure transducers include these facilities:

- CANopen software standards
- Digital output
- CAN bus serial communications interface
- Isolated input/output.

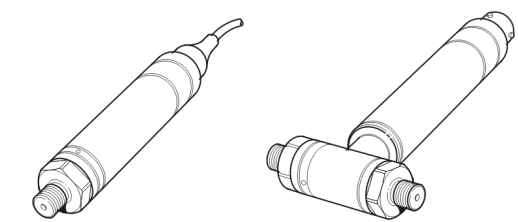


Figure 1-1: DPS 4000 Series - General views

Applications

The DPS 4000 series is for automated systems that use a CAN bus network and CANopen software standards. The pressure transducers in the DPS 4000 series are ideal for automated systems that must have:

- A large amount of digital pressure data very quickly
- A high level of accuracy over a wide temperature range
- A sophisticated level of software control.

Summary of facilities

Because all the transducers in the DPS 4000 series use CANopen software standards, each transducer includes a CANopen Object Dictionary. You can use the CANopen Object Dictionary to do these primary tasks:

- Monitor the current pressure and temperature data.
- Tag the type of data. For example: Oil-mbar, H2O-mbar.
- Read the factory defined operating data. For example, the pressure range, and the type of sensor.
- Set the update frequency for the pressure and temperature data.
- Set the pressure units. You can set SI units or you can set alternative units.
- Monitor the current status.
- Read and set the last and next calibration date.
- Set new calibration values.
- Set local pressure and temperature limits for use with the internal out-of-limit counters.
- Monitor the number of times the pressure is not in the specified limits.
- Monitor the number of times the temperature is not in the specified limits.
- Restore all the factory default values for the CANopen Object Dictionary.

You can use a standard CANopen software package to get access to the contents of the CANopen Object Dictionary.

Summary of the CANopen set of functions

NMT:	Slave
Error Control:	Node Guarding or Heartbeat
Node ID:	LSS (DSP-305 V1.0)
No. of PDOs:	0 Receive and 1 Transmit
PDO Modes:	Event triggered or Remotely requested
PDO Linking:	Yes
PDO Mapping:	Default
No. of SDOs:	1 Server and 0 Client
Emergency Message:	Yes
CANopen Version:	DS-301 V4.01
Framework:	No
Certified:	No
Device Profile:	DSP-404 V1.0
Baud rate:	250 kbit/s (LSS: DSP-305 V1.0)

The pressure transducer you receive

These items are etched onto the body of the pressure transducer you receive:

Druck DPS4xxx	Identifies the model number
xxx xxxx x Example: 350 mbar g	Identifies the pressure range and type: Gauge (g), Absolute (a), Differential (d)
7.5 TO 30 Vdc	Identifies the voltage range.
S/N xxxxxxx	Identifies the serial number.

Make sure that the data is correct. The data below identifies the structure of the ‘Ordering Information’:

1. The Model number. For example DPS4060:

DPS	Basic Type Number		
	Code	Pressure Type	
	40	Gauge or Absolute	
	41	Differential	
		Code	Electrical Connection
		10	6-core vented screened cable (1 metre)
		60	6-pin bayonet plug

2. The pressure range
3. The version: Gauge, Absolute or Differential
4. The pressure connection (refer to section 2)
5. The applicable options:
   (A) Mating connector for the 6-pin bayonet plug
   (B) Negative calibration
   (C) Alternative engineering units (psi)
   (D) User instruction handbook (this user manual)

2. Technical data

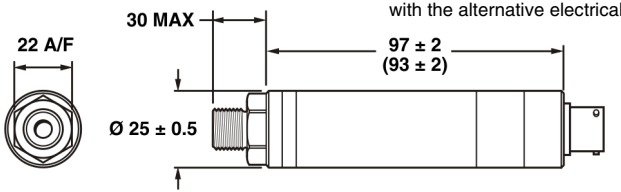
Physical data

Dimensions

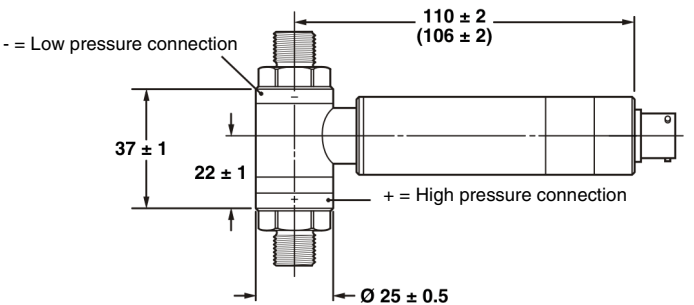
Note:

All dimensions are in mm (not to scale).

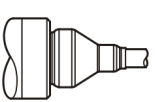
(x ± 2): Identifies a dimension for versions with the alternative electrical connection.



(1) Gauge or Absolute version
with typical connection details - 6-pin bayonet plug shown attached



(2) Differential version
with typical connection details - 6-pin bayonet plug shown attached



(3) Alternative electrical connection:
6-core vented screened cable

Figure 2-1: Typical dimensions

Weight

Type of transducer	Electrical connection	Nominal weight Grams (g)
Gauge/Absolute	6-pin bayonet plug	180 g
Gauge/Absolute	6-core vented screened cable	215 g
Differential	6-pin bayonet plug	230 g
Differential	6-core vented screened cable	265 g

The type of pressure connection can affect the nominal weight by up to 10 grams.

Compatible pressure media

Type of transducer	Type of media
Gauge, Absolute, Differential positive port	Media that is compatible with stainless steel 316L and Hastelloy C276.
Differential negative port	Media that is compatible with stainless steel 316L, silicon, Pyrex and epoxy resin.

Physical connections

Table 2-1 supplies a nominal list of physical connections. For alternative connections, speak to Technical support.

Table 2-1: Physical connections

Pressure connections	Electrical connections
Male: G 1/8B (60° Internal cone)	6-Pin bayonet plug
Male: G 1/4B (60° Internal cone)	6-core vented screened cable
Male: G 1/4B (Flat end)	
Male: 1/4" NPT	
Male: 7/16" UNF	
Male: M14 x 1.5 (to DIN 3863-8)	
Female: G 1/4	
Female: 1/4" NPT	

Performance data

Pressure performance

These notes apply to table 2-2:

Pressure ranges: The table identifies the compensated pressure ranges. This includes negative ranges (if you specified this option – Maximum: - 1 bar) and the zero-based ranges.

Over pressure limits: The transducers stay in calibration (with negligible change) if you keep to the specified limits.

For the differential pressure transducers, you must keep to both the line pressure limits and the over pressure limits.

Table 2-2: (Part of table) Pressure ranges and limits

	Gauge pressure transducers	**Absolute pressure transducers**	**Differential pressure transducers**
Pressure ranges	mbar: 350, 700 bar: 1, 2, 3.5, 7, 10, 20, 35, 70	mbar: 700 bar: 1, 2, 3.5, 7, 10, 20, 35, 70	mbar: 350, 700 bar: 1, 2, 3.5, 7, 10, 20, 35
Over pressure limits	Absolute vacuum to +4 x FS (maximum: 140 bar)	Absolute vacuum to +4 x FS (maximum: 140 bar)	Differential pressure from: -2 x FS (maximum: -10 bar) to +4 x FS (maximum: 100 bar)
Pressure containment limits	+4 x FS (maximum: 200 bar)	Maximum: 200 bar	Positive port: +4 x FS (maximum: 200 bar) Negative port: +4 x FS (maximum: 15 bar)

Table 2-2: (Part of table) Pressure ranges and limits

	Gauge pressure transducers	Absolute pressure transducers	Differential pressure transducers
Line pressure limits	Not applicable	Not applicable	Maximum: 35 bar

Temperature performance

Operating temperature range: - 40 °C to + 80 °C

Compensated temperature range: + 10 °C to + 60 °C

Accuracy – Pressure and temperature measurements

Table 2-3 shows the accuracy of the pressure and temperature measurements over the compensated ranges. The values for the pressure accuracy include all sources of error except for these items:

- Long term drift
- Effects of line pressure (differential pressure versions only)

Table 2-3: Pressure and temperature accuracy

Compensated pressure range	Pressure accuracy (Rate of new data = 10 Hz)	Temperature accuracy
All zero-based pressure ranges	0.2% of reading down to 50% of full-scale (FS), then 0.1% FS down to zero (refer to Note).	±2 °C over the compensated pressure and temperature ranges
All gauge and differential ranges (This includes negative calibration ranges)	0.2% FS (refer to Note).	±2 °C over the compensated pressure and temperature ranges

Note:

If you set the rate of new data to 100 Hz, this increases the noise level for the data. The noise adds an uncertainty of 0.05% full-scale (FS) to the accuracy figures in table 2-3.

Long-term stability

As a typical value, the long-term stability is better than 0.08% FS each year.

Electrical data

Power supply:	7.5 VDC to 30 VDC
Insulation resistance:	Greater than 100 MΩ at 500 VDC: - between the transducer body and all the signal lines - between the power supply lines and the CAN bus data lines
Power consumption:	Less than 1 Watt

Environmental data

Pressure Equipment Directive

Class of equipment: Pressure accessory, Category 1

Electromagnetic Compatibility (EMC)

If correctly installed, the pressure transducers operate to these EMC standards:

Emissions:	EN 50081-1 (Light industrial standard)
Immunity:	EN 61000-6-2 (Heavy industrial standard)

Effects of vibration and shock

Table 2-4 shows the effects of vibration and shock on the transducer performance (g = Acceleration of Gravity).

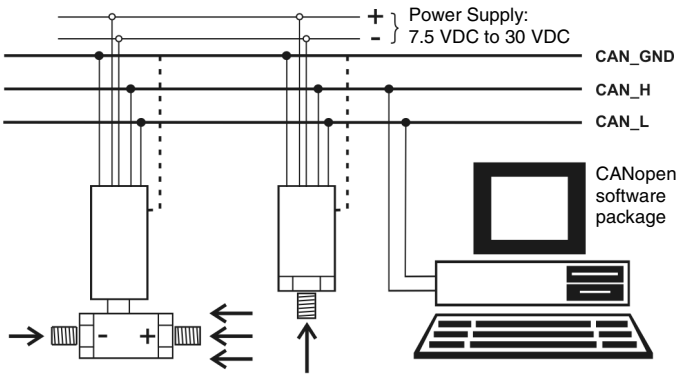
Table 2-4: Effects of vibration and shock

Vibration conditions	**Change in readings**
30g peak 10 Hz to 2 kHz, limited by 12 mm double amplitude	Less than 0.05% FS/g
20g peak to MIL-STD 810C PROC 514.2-2 Curve L	Less than 0.05% FS/g
Mechanical shock conditions	
1000g, 1 ms Half sine pulse in each of three mutually perpendicular axes	No effect

3. Installation data

This section supplies data to help you install the pressure transducer. When you complete the installation, you can prepare the pressure transducer for operation (refer to section 4).

Installation – An example CAN bus system



CAN_X	Identifies the signal line connections on the CAN bus (refer to table 3-1).
- - - -	6-core cable connection - Cable screen to CAN_GND or an applicable earth
→	Represents the different pressure conditions in the example system.
- +	Differential version only: + = High-pressure connection, - = Low-pressure connection.

Figure 3-1: An example CAN bus system

Figure 3-1 shows the pressure transducers in an example CAN bus system. You must have these items:

- A CAN bus with an applicable input/output device for the signal lines (applicable to the electrical connection on the pressure transducer)
- Power supply: 7.5 VDC to 30 VDC

- All applicable tools to connect and adjust the pressure connection. Refer to the applicable system installation manual.
- All applicable tools to connect and test the electrical connection. Refer to the applicable system installation manual.

Installation – Before you start

Make sure that you have the correct pressure transducer (refer to section 1).

Before you install the pressure transducer, read the applicable system installation manual for all applicable instructions and procedures.

Read all the installation data that appears here before you install the unit. Follow good engineering practice at all times.

Installation – Procedures

WARNING

- **Do not interchange transducers between an oil system and a system that uses fuel or gas. This can cause an explosion that can cause death or injury, and/or damage to equipment.**
- **High pressures and temperatures are dangerous (refer to the pressure limits in table 2-2). Be careful when you do work on components connected to lines that have high pressures and heat. Use the applicable protection and obey all safety precautions.**
- **Be careful when you do work on components with connections to an electrical supply. When possible, do the work with the electrical supply disconnected. Electrical shocks can cause death or injury.**

CAUTION

Until you are prepared to install the unit, keep it in the original container with all the covers in position. The container and covers prevent contamination and damage. When not in use, keep the connections clean at all times, and put the covers on the open connections.

Pressure connections – Gauge or Absolute

1. When you are prepared to attach the pressure connection, remove the cover from the connection.
2. Attach the pressure connection to the pressure system and torque the connection (refer to the system installation manual)

Pressure connections (+ and -) – Differential

1. When you are prepared to attach the pressure connection, remove the cover from the connection.
2. Check the connection for the + or – mark (+ = High pressure connection, - = Low pressure connection).
3. Attach the pressure connection to the applicable side of the pressure system (+ or -) and torque the connection (refer to the system installation manual).

Electrical connections

Table 3-1 supplies the connection data for each type of electrical connection.

Table 3-1: Electrical connections

6-Pin bayonet plug	6-core vented screened cable	Data
A	Orange	CAN_GND (CAN Ground)
B	Red	Positive supply
C	White	Negative supply
D	Yellow	CAN_H (CAN H bus line - dominant high)
E	Blue	CAN_L (CAN L bus line - dominant low)
F	Black	Not connected
	Cable vent tube	Used for gauge versions only. Connected to the reference side of the silicon pressure sensor.
	Cable screen	Connected to the transducer body
	Kevlar tape	Yellow Kevlar tape. Breaking strain: 54 kg.

Electrical connections – 6-Pin bayonet plug

1. When you are prepared to attach the 6-Pin bayonet plug, remove the cover from the connection.
2. Attach the 6-Pin bayonet plug to the applicable CAN bus connection (refer to the system installation manual).

Electrical connections – 6-core vented screened cable

1. Use table 3-1 to identify the connections that are available.
2. Attach the connections as necessary (refer to the system installation manual):

- Attach the CAN bus connections and the power supply.
- Attach the cable screen to CAN_GND or an applicable earth (to get the specified EMC standards).
- (Gauge versions only) Connect the cable vent tube to the applicable pressure reference point.

3. (Gauge versions only) Make sure that there are no items of equipment that can cause a blockage for the cable vent tube. If necessary, move the item of equipment that can cause a blockage.

To complete the installation

To complete the installation, do all the applicable tests and checks (refer to the system installation manual).

When you complete the installation, you can prepare the pressure transducer for operation (refer to section 4).

4. Operation

The data that appears in this section includes:

- A description of the primary components in the pressure transducer
- The procedures to start and change the operation of the pressure transducer
- The data available from the pressure transducer

Note:

0x identifies a hexadecimal value. Object 0x1800 02 = Index 0x1800, Sub-index 0x02 (refer to appendix A).

Operation – The primary components

The pressure transducer includes these primary components:

- A piezo-resistive silicon sensor to supply the pressure data.
- A temperature diode to supply the temperature data.
- An Analogue-to-Digital Converter (ADC) and a microprocessor board to prepare and store the data in the CANopen Object Dictionary.
- Memory to store the CANopen Object Dictionary and the factory default values.
- Isolated input and output to give full system protection.
- A CAN bus serial interface to connect the unit to the CAN bus network.

Operation – Before you start

Before you start, make sure of these items:

- The installation is completed (refer to section 3).
- You have a CANopen software package to get access to the contents of the CANopen Object Dictionary.
- You know the operation of your CANopen network. This includes the Network Initialisation Process (the Boot-up process) and/or the applicable configuration procedures.

Operation – Procedures to get started

1. Complete the boot-up procedure for your CAN bus network.

   Figure 4-1 shows how the pressure transducer uses the default values to transmit a Process Data Object (PDO).

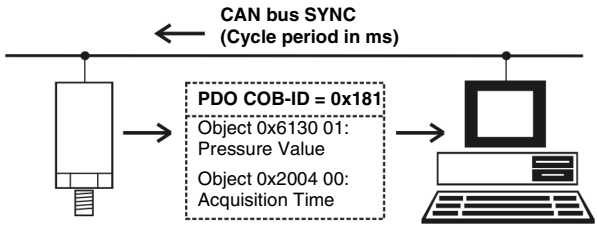


Figure 4-1: The default 'Transmit PDO' operation

   The default rate for new pressure and temperature data is 10 Hz. To get the best performance, we recommend you set the cycle period for the SYNC object to 100 ms (refer to objects 0x210A/0x210B).

2. Use your CANopen software package to receive the PDO and get access to the CANopen Object Dictionary (refer to appendix A).

You can use your CANopen software package to change these values:

- Values set with the Layer Setting Services (LSS)
- Values in the CANopen Object Dictionary.

The procedures that follow identify the primary objects that you can change and monitor.

To change the operation – Node ID and Baud rate

You must use the CANopen Layer Setting Services (LSS) to change these primary items in the pressure transducer:

- The node ID (default value = 1)
- The baud rate (default value = 250 kbits/s).

When you use the LSS, you must identify the device. Object 0x1018 (Identity) contains the identification data. Refer to *References.*

To change the operation – Objects: 0x1000 – 0x1FFFF

0x100C to 0x100E – Error control: Node Guarding option

To use Node Guarding for error control, set applicable values for these objects:

- 0x100C (Guard Time)
- 0x100D (Life Time factor)
- 0x100E (Node Guarding Identifier).

Refer to *References* for more data.

0x1017 – Error control: Heartbeat option

To use Heartbeat for error control, set applicable values for these objects:

- 0x100E (Node Guarding Identifier)
- 0x1017 (Heartbeat Time).

Refer to *References* for more data.

0x1011 01 – To reapply the factory values

Use object 0x1011 01 (Load All Parameters) to reapply all the factory values.

Example:

Set the value to 0x64616F6C = doal (in ASCII)

0x1800 02 – The PDO transmission (Type or period)

Use object 0x1800 02 (Transmission Type) to change the type of PDO transmission or the period between each PDO transmission (refer to *References*).

0x1A00 – The data in the 'Transmit PDO'

Use object 0x1A00 (Transmit PDO Mapping) to change the data that is sent in the 'Transmit PDO' (Maximum size = 8 bytes).

Example:

- To monitor the current status of the pressure value, set Sub-index 0x02 to 0x61500108 = Object 0x6150 01, 1 byte of data.

  Status = 0: The value is in the limits given in 0x6148 and 0x6149.

  Status = 1: The value is more than the limit given in 0x6149.

  Status = 2: The value is less than the limit given in 0x6148.

To change the operation – Objects: 0x2000 – 0x2FFFF

0x210A/0x210B – The rate of new data

Use object 0x210A (Pressure Scan Count) and Object 0x210B (Temperature Scan Count) to change the rate of new pressure and temperature data (10 Hz or 100 Hz). 10 Hz is the default rate.

Example:

1. Set the applicable value for 0x210A:

   For 10 Hz, set the value to 60.
   For 100 Hz, set the value to 2.

2. Set the same rate (10 Hz or 100 Hz) for Object 0x210B

   For 10 Hz, set the value to 20.
   For 100 Hz, set the value to 200.

Note:

If you set the rate of new data to 100 Hz, this increases the noise level for the data. The noise adds an uncertainty of 0.05% full-scale (FS) to the accuracy figures in table 2-3.

To get the best performance from the pressure transducer, you must set an applicable cycle period for the SYNC object. For 10 Hz, we recommend you set the cycle period to 100 ms. For 100 Hz, we recommend you set the cycle period to 10 ms.

0x2200 – To change the calibration data

To write new calibration values in objects 0x2201 to 0x220A, set object 0x2200 (Calibration Access Pin) to 4118.

To prevent accidental changes to the calibration data, set the value to 0 when you complete all the changes.

0x2201 to 0x2203 – The last calibration year, month, day

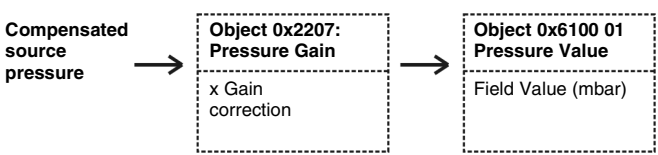
Refer to 0x2200 (Calibration Access Pin). The initial values identify the date of the factory calibration. Set a new date each time you do a calibration (refer to section 5).

0x2204 to 0x2206 – The next calibration year, month, day

Refer to 0x2200 (Calibration Access Pin). The initial values identify the date of the factory calibration + one year. Set a new date each time you do a calibration (refer to section 5).

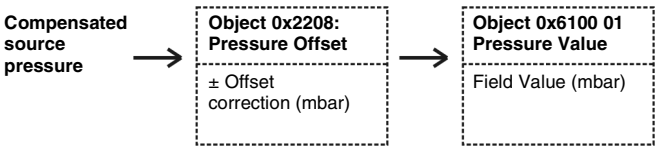
0x2207 – The pressure calibration gain

Refer to 0x2200 (Calibration Access Pin). Use 0x2207 (Pressure Gain) to apply a correction to the compensated source pressure (refer to section 5).



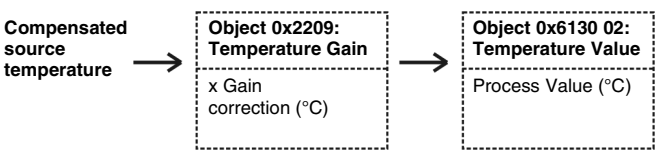
0x2208 – The pressure calibration offset

Refer to 0x2200 (Calibration Access Pin). Use 0x2208 (Pressure Offset) to apply a correction to the compensated source pressure (refer to section 5).



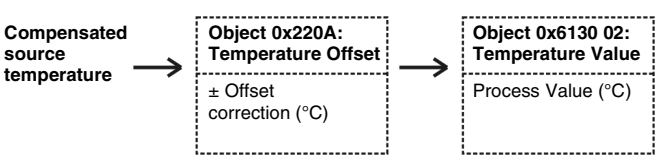
0x2209 – The temperature calibration gain

Refer to 0x2200 (Calibration Access Pin). Use 0x2209 (Temperature Gain) to apply a correction to the compensated source temperature.



0x220A – The temperature calibration offset

Refer to 0x2200 (Calibration Access Pin). Use 0x220A (Temperature Offset) to apply a correction to the compensated source temperature.



0x2304 – The tag for the type of data

Use object 0x2304 (Tag) to identify the type of data that the pressure transducer supplies (Maximum: 10 Characters). For example: Oil-mbar.

To change the operation – Objects: 0x6000 – 0x6FFFF

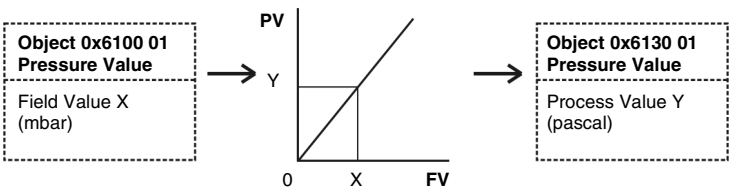
0x6120 to 0x6124 – The scale data for the pressure output

The pressure transducer uses a two-point calibration to calculate the pressure output. The two-point calibration includes the relation between the Field Value (FV) units and the Process Value (PV) units.

To change the relation between FV and PV, use the scale-factor objects and the zero offset. This allows you to read the pressure output in one of the alternative pressure units.

Example:

Set object 0x6123 01 to 100 (the scale-factor for pascal)



For a list of values you can use to get one of the alternative pressure units, refer to appendix B.

0x6131 01 – The units for the pressure output

Use object 0x6131 01 (Pressure Value) to change the units for the pressure output.

Example:

Set Sub-index 0x01 to 0x00220000 = CANopen value for pascal

For a list of values you can use to get one of the alternative pressure units, refer to appendix B.

0x6148 – The local limits (minimum pressure and temperature)

Use object 0x6148 (Span Start – FP) to set the local limits for the pressure transducer operation. Set the applicable minimum values for the pressure and temperature (refer to 0x2007/0x2009 in this section).

0x6149 – The local limits (maximum pressure and temperature)

Use object 0x6149 (Span End – FP) to set the local limits for the pressure transducer operation. Set the applicable maximum values for the pressure and temperature (refer to 0x2006/0x2008 in this section).

To monitor the operation – Objects: 0x1000 – 0x1FFFF

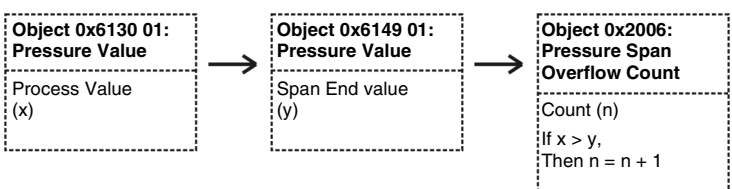
0x1001 – The status of the unit

Use object 0x1001 (Error Register) to monitor the current status of the unit.

To monitor the operation – Objects: 0x2000 – 0x2FFFF

0x2006 – The count: Pressure is more than the limit

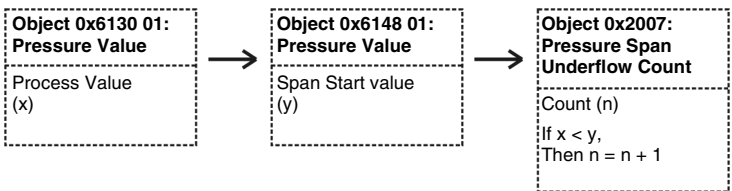
Use object 0x2006 (Pressure Span Overflow Count) to monitor the pressure history. The count increases in increments of one each time the process value is more than the span end value.


Object 0x6130 01: Pressure Value
Process Value (x)
Object 0x6149 01: Pressure Value
Span End value (y)
Object 0x2006: Pressure Span Overflow Count
Count (n)
If x > y,
Then n = n + 1

You can reset the count when applicable. For example: after calibration.

0x2007 – The count: Pressure is less than the limit

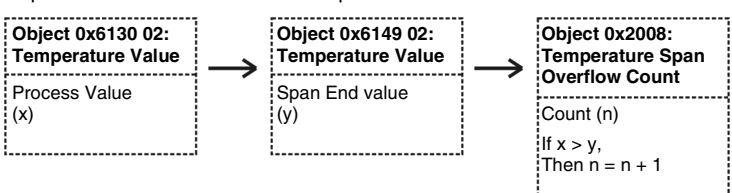
Use object 0x2007 (Pressure Span Underflow Count) to monitor the pressure history. The count increases in increments of one each time the process value is less than the span start value.


Object 0x6130 01: Pressure Value
Process Value (x)
Object 0x6148 01: Pressure Value
Span Start value (y)
Object 0x2007: Pressure Span Underflow Count
Count (n)
If x < y, Then n = n + 1

You can reset the count when applicable. For example: after calibration.

0x2008 – The count: Temperature is more than the limit

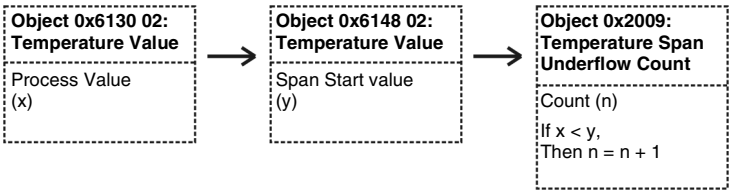
Use object 0x2008 (Temperature Span Overflow Count) to monitor the temperature history. The count increases in increments of one each time the process value is more than the span end value.


Object 0x6130 02: Temperature Value
Process Value (x)
Object 0x6149 02: Temperature Value
Span End value (y)
Object 0x2008: Temperature Span Overflow Count
Count (n)
If x > y, Then n = n + 1

You can reset the count when applicable. For example: after calibration.

0x2009 – The count: Temperature is less than the limit

Use object 0x2009 (Temperature Span Underflow Count) to monitor the temperature history. The count increases in increments of one each time the process value is more than the span end value.


Object 0x6130 02: Temperature Value
Process Value (x)
Object 0x6148 02: Temperature Value
Span Start value (y)
Object 0x2009: Temperature Span Underflow Count
Count (n)
If x < y,
Then n = n + 1

You can reset the count when applicable. For example: after calibration.

To monitor the operation – Objects: 0x6000 – 0x6FFFF

0x6130 01/0x6130 02 – The pressure and temperature

Use object 0x6130 01 (Pressure Value) and object 0x6130 02 (Temperature Value) to monitor the current process values. The process values include the calibration corrections (objects 0x2207 to 0x220A), and the applicable scale and offset data (objects 0x6120 to 0x6124).

You can use object 0x1A00 (Transmit PDO Mapping) to put the applicable data in the 'Transmit PDO'.

0x6150 – The pressure and temperature status

Use object 0x6150 (Status) to monitor the current status of the pressure and temperature output.

Status = 0: The value is in the limits given in 0x6148 and 0x6149.

Status = 1: The value is more than the limit given in 0x6149.

Status = 2: The value is less than the limit given in 0x6148.

5. Maintenance

WARNING

- **High pressures and temperatures are dangerous (refer to the pressure limits in table 2-2). Be careful when you do work on components connected to lines that have high pressures and heat. Use the applicable protection and obey all safety precautions.**
- **Be careful when you do work on components with connections to an electrical supply. When possible, do the work with the electrical supply disconnected. Electrical shocks can cause death or injury.**

CAUTION

When not in use, keep the connections clean at all times, and put covers on the open connections. The covers prevent contamination and damage.

You can do these maintenance tasks:

- Identify faults from the software
- Clean the unit
- Recalibrate the unit.

Note:

Druck can provide a calibration service that is traceable to international standards.

You must return the unit to the supplier for these items:

- For all repairs
- For changes or upgrades to the internal software.

Maintenance – From the software

Note:

0x identifies a hexadecimal value. Object 0x1800 02 = Index 0x1800, Sub-index 0x02 (refer to appendix A).

The status of the unit

To monitor the current status of the unit, you can use these sources of error data:

- The Error control facilities - refer to section 4
- The Error Register (object 0x1001) - refer to section 4

If there is an error:

- Do the Network Initialisation Process (the Boot-up process) again.
- Examine the electrical connections. Do all the applicable tests and checks (refer to the system installation manual).
- If necessary, install a new pressure transducer.

Maintenance – Cleaning

CAUTION

Do not use high-pressure gas to remove dirt from the unit. This can damage the sensor in the unit.

1. If necessary, remove the unit.
2. Clean the unit with a lint-free cloth and a soft brush. If necessary, make the cloth moist with a weak solution of detergent.
3. (For gauge versions with a 6-core vented screened cable) Make sure that there is no blockage in the cable vent tube. If necessary, remove the blockage.
4. Allow the unit to dry before you use it again.

Maintenance – Calibration

Druck supplies a calibration certificate with the pressure transducer. When it is necessary to recalibrate the pressure transducer, use the procedure that appears below (Druck recommends a minimum interval of once a year).

Note:

Druck can provide a calibration service that is traceable to international standards.

Calibration – The equipment you need

Druck recommends that you use these items of equipment to calibrate the unit:

- Pressure source - minimum accuracy: 0.05% of reading
- Digital thermometer - minimum accuracy: 1 °C
- A CANopen software package to get access to the contents of the CANopen Object Dictionary (refer to appendix A).

Druck make a range of precision calibrators, pressure controllers, dead-weight testers, and calibration software. Please refer to Druck for further information on these products.

Two-point pressure calibration – Procedure

Note:

0x identifies a hexadecimal value. Object 0x1800 02 = Index 0x1800, Sub-index 0x02 (refer to appendix A).

To get accurate results, you must do the calibration in conditions where the pressure and temperature are stable.

1. Record the current values for the calibration data:

- Object 0x2207 00 (Pressure Gain) = GAIN
  Default value = 1
- Object 0x2208 00 (Pressure Offset) = OFFSET
  Default value = 0 mbar

2. Do the first calibration point:
   a. Apply pressure (AP1) at 10% of the full-scale pressure (in mbar) and allow the pressure to become stable.
   b. Record the field value (FV1) that appears in object 0x6100 01 (Pressure Value). Record the value in mbar.
3. Do the second calibration point:
   a. Apply pressure (AP2) at 90% of the full-scale pressure (in mbar) and allow the pressure to become stable.
   b. Record the field value (FV2) that appears in object 0x6100 01 (Pressure Value). Record the value in mbar.
4. Calculate the new values for the calibration data:

- NEW GAIN = [GAIN] * [(AP1 - AP2) / (FV1 - FV2)]
- NEW OFFSET = [(OFFSET) - FV1]
  + [(AP1) * [(AP1 - AP2) / (FV1 - FV2)]]

The value for the NEW OFFSET is in mbar.

5. Write the new values for the calibration data back to the CANopen Object Dictionary:
   a. Set object 0x2200 00 (Calibration Access Pin) to 4118
   b. Set object 0x2207 00 (Pressure Gain) to the NEW GAIN value
   c. Set object 0x2208 00 (Pressure Offset) to the NEW OFFSET value. The value for the NEW OFFSET is in mbar.
   d. Set object 0x2200 00 (Calibration Access Pin) to 0
6. Confirm that the new values for the calibration data are correct:

- Do steps 2 and 3 again.

7. Write the new values for the last and next calibration dates back to the CANopen Object Dictionary:
   a. Set object 0x2200 00 (Calibration Access Pin) to 4118
   b. Set objects 0x2201 00 to 0x2203 00 to the new values for the last calibration year, month, day

c. Set objects 0x2204 00 to 0x2206 00 to the new values for the next calibration year, month, day

d. Set object 0x2200 00 (Calibration Access Pin) to 0

8. If applicable, reset the values for the out-of-limit counters (objects 0x2006 to 0x2009).

Two-point pressure calibration – Results

For correct operation, the value for the NEW GAIN is in the range 0.9 to 1.1. If the value is not in this range, this shows either a defective unit or defective calibration equipment.

Approved Service Agents

These are the approved service agents for Druck instruments:

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Appendix A

DPS 4000 Series – CANopen Object Dictionary

This appendix contains data for the primary objects that appear in these areas of the CANopen Object Dictionary:

- Communication Profile Area: 0x1000 – 0x1FFFF
- Manufacturer Specific Profile Area: 0x2000 – 0x2FFFF
- Standardised Device Profile Area: 0x6000 – 0x6FFFF

The data appears in a table with two parts. Part A identifies the structure of the applicable object entries. Part B identifies some of the values and data applicable to each object entry.

Note:

0x identifies a hexadecimal value.

R = Read, W=Write.

Refer to *References* for more data.

0x1000 / 0x1017

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x1000	0x00	Device Type	4	UNSIGNED32
0x1001	0x00	Error Register	1	UNSIGNED8
0x1005	0x00	COB-ID Sync message	4	UNSIGNED32
0x1008	0x00	Device Name	48	VIS_STNG48
0x100C	0x00	Guard Time	2	UNSIGNED16
0x100D	0x00	Life Time	1	UNSIGNED8
0x100E	0x00	Node Guarding ID	4	UNSIGNED32
0x1010		Store Parameters		
	0x00	No of entries	1	UNSIGNED32
	0x01	Save All Parameters	4	UNSIGNED32
0x1011		Restore Parameters		
	0x00	Number of Entries	1	UNSIGNED32
	0x01	Load All Parameters	4	UNSIGNED32
0x1012	0x00	COB-ID Time Stamp	4	UNSIGNED32
0x1014	0x00	COB-ID Emergency	4	UNSIGNED32
0x1017	0x00	Heartbeat Time	2	UNSIGNED16

0x1000 / 0x1017

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x1000	0x00	R	0x00020194	DSP404 Analogue Input
0x1001	0x00	R	0	No errors
0x1005	0x00	RW	0x080	ID 128, No SYNC generation
0x1008	0x00	R	DPS4xx0 DK226v xx.xx	
0x100C	0x00	RW	0	Error control: Off
0x100D	0x00	RW	0	Error control: Off
0x100E	0x00	RW	0x701	0x700 + Node ID = ID 1793
0x1010				
	0x00	R	1	
	0x01	R	0x00000002	Saves autonomously
0x1011				
	0x00	R	1	
	0x01	RW	0x00000001	0x64616F6C = doal (ASCII): To reapply all the factory values.
0x1012	0x00	R	0x100	ID 256
0x1014	0x00	R	0x081	0x080 + Node ID = ID 129
0x1017	0x00	RW	0	Error control: Off

0x1018 / 0x1A00

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x1018		Identity		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Vendor ID	4	UNSIGNED32
	0x02	Product Code	4	UNSIGNED32
	0x03	Revision Number	4	UNSIGNED32
	0x04	Serial Number	4	UNSIGNED32
0x1200		Server SDO		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	COB-ID Client-Server	4	UNSIGNED32
	0x02	COB-ID Server-Client	4	UNSIGNED32
0x1800		Transmit PDO		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	COB-ID	4	UNSIGNED32
	0x02	Transmission Type	1	UNSIGNED8
	0x05	Event Timer	2	UNSIGNED16
0x1A00		Transmit PDO Mapping		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Mapping 1	4	UNSIGNED32
	0x02	Mapping 2	4	UNSIGNED32
	0x03	Mapping 3	4	UNSIGNED32
	0x04	Mapping 4	4	UNSIGNED32

0x1018 / 0x1A00

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x1018				
	0x00	R	4	
	0x01	R	0x00000050	DRUCK
	0x02	R	Model No.	Example: 4160
	0x03	R	Revision No.	Example: 0x00010001
	0x04	R	Serial No.	
0x1200				
	0x00	R	2	
	0x01	R	0x601	0x600 + Node ID = ID 1537
	0x02	R	0x581	0x580 + Node ID = ID 1409
0x1800				
	0x00	R	5	
	0x01	R	0x181	0x180 + Node ID = ID 385
	0x02	RW	1	Transmit on every SYNC
	0x05	RW	0	Not used
0x1A00				
	0x00	R	4	
	0x01	RW	0x61300120	Process Value (Pressure)
	0x02	RW	0x20040020	Acquisition Time
	0x03	RW	0x00000000	Not used
	0x04	RW	0x00000000	Not used

0x2003 / 0x2206

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x2003	0x00	Current Time	6	TIME_OF_DAY
0x2004	0x00	Acquisition Time	4	UNSIGNED32
0x2005	0x00	Acquisition Interval	2	UNSIGNED16
0x2006	0x00	Pressure Span Overflow Count	2	UNSIGNED16
0x2007	0x00	Pressure Underflow Count	2	UNSIGNED16
0x2008	0x00	Temperature Overflow Count	2	UNSIGNED16
0x2009	0x00	Temperature Underflow Count	2	UNSIGNED16
0x210A	0x00	Pressure Scan Count	1	UNSIGNED8
0x210B	0x00	Temperature Scan Count	1	UNSIGNED8
0x2200	0x00	Calibration Access Pin	2	UNSIGNED16
0x2201	0x00	Last Calibration Year	2	UNSIGNED16
0x2202	0x00	Last Calibration Month	2	UNSIGNED16
0x2203	0x00	Last Calibration Day	2	UNSIGNED16
0x2204	0x00	Next Calibration Year	2	UNSIGNED16
0x2205	0x00	Next Calibration Month	2	UNSIGNED16
0x2206	0x00	Next Calibration Day	2	UNSIGNED16

0x2003 / 0x2206

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x2003	0x00	R	0	The current time (usually set by 0x1012)
0x2004	0x00	R	0	The time the ADC supplied the data (in ms after midnight)
0x2005	0x00	R	0	
0x2006	0x00	RW	0	Count: More than the local limit
0x2007	0x00	RW	0	Count: Less than the local limit
0x2008	0x00	RW	0	Count: More than the local limit
0x2009	0x00	RW	0	Count: Less than the local limit
0x210A	0x00	RW	60	60 = 10 Hz (Rate of new data) 2 = 100 Hz (Rate of new data)
0x210B	0x00	RW	20	20 = 10 Hz (Rate of new data) 200 = 100 Hz (Rate of new data)
0x2200	0x00	RW	0	0 = No write access 4118 = Write access
0x2201	0x00	RW	Year of calibration	To write, refer to 0x2200
0x2202	0x00	RW	Month of calibration	To write, refer to 0x2200
0x2203	0x00	RW	Day of calibration	To write, refer to 0x2200
0x2204	0x00	RW	Year of next calibration	To write, refer to 0x2200
0x2205	0x00	RW	Month of next calibration	To write, refer to 0x2200
0x2206	0x00	RW	Day of next calibration	To write, refer to 0x2200

0x2207 / 0x2304

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x2207	0x00	Pressure Gain	4	REAL32
0x2208	0x00	Pressure Offset	4	REAL32
0x2209	0x00	Temperature Gain	4	REAL32
0x220A	0x00	Temperature Offset	4	REAL32
0x2300	0x00	Min Pressure	4	INTEGER32
0x2301	0x00	Max Pressure	4	INTEGER32
0x2302	0x00	Sensor Type	1	UNSIGNED8
0x2303	0x00	Acquisition Period	2	UNSIGNED16
0x2304	0x00	Tag	10	VIS_STRNG10

0x2207 / 0x2304

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x2207	0x00	RW	1	Gain correction. To write, refer to 0x2200.
0x2208	0x00	RW	0	Offset correction in mbar. To write, refer to 0x2200.
0x2209	0x00	RW	1	Gain in °C. To write, refer to 0x2200.
0x220A	0x00	RW	0	Offset in °C. To write, refer to 0x2200.
0x2300	0x00	R	Minimum pressure	Calibrated pressure value in mbar (Minimum)
0x2301	0x00	R	Maximum pressure	Calibrated pressure value in mbar (Maximum)
0x2302	0x00	R	0 = Absolute 128 = Gauge 255 = Differential	Mode of operation
0x2303	0x00	R	100	Nominal interval for new data: 100 ms = 10 Hz operation 10 ms = 100 Hz operation
0x2304	0x00	RW	[blank]	Free-format text Maximum: 10 characters

0x6100 / 0x6122

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x6100		Field Value – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
0x6101		Field Physical Units		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	UNSIGNED32
0x6110		Sensor Type		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	2	UNSIGNED16
0x6120		Input Scaling 1 FV – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
0x6121		Input Scaling 1 PV – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
0x6122		Input Scaling 2 FV – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32

0x6100 / 0x6122

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x6100				
	0x00	R	1	
	0x01	R	0	Pressure (Field Value)
0x6101				
	0x00	R	1	
	0x01	R	0xFD4E0000 = mbar	Units for 0x6100 01
0x6110				
	0x00	R	1	
	0x01	R	90	Pressure Transducer
0x6120				
	0x00	R	1	
	0x01	RW	0	Scale-factor: Lower calibration point = zero (Field Value)
0x6121				
	0x00	R	1	
	0x01	RW	0	Scale-factor: Lower calibration point = zero (Process Value)
0x6122				
	0x00	R	1	
	0x01	RW	1	Scale-factor: Higher calibration point = mbar (Field Value)

0x6123 / 0x6131

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x6123		Input Scaling 2 PV – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
0x6124		Zero Offset – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
0x6125		Auto Zero		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	UNSIGNED32
0x6130		Process Value – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
	0x02	Temperature Value	4	REAL32
0x6131		Process Physical Units		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	UNSIGNED32
	0x02	Temperature Value	4	UNSIGNED32

0x6123 / 0x6131

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x6123				
	0x00	R	1	
	0x01	RW	1 = mbar 0.001 = bar 0.0145038 = psi	Scale-factor: Higher calibration point (Process Value)
0x6124				
	0x00	R	1	
	0x01	RW	0	Offset = 0
0x6125				
	0x00	R	1	
	0x01	RW	0x00000000	0x6F72657A = orez (ASCII): To reset 0x6100 01 to zero.
0x6130				
	0x00	R	2	
	0x01	R	0	Pressure (Process Value)
	0x02	R	0	Temperature (Process Value)
0x6131				
	0x00	R	2	
	0x01	RW	0xFD4E0000 = mbar 0x004E0000 = bar 0x00A00000 = psi	Units for 0x6130 01
	0x02	RW	0x002D0000 = °C	Units for 0x6130 02

0x6148 / 0x6150

Table A-1 (Part A): Object Dictionary – Structure

Index	Sub-Index	Name	Data Size	Data Type
0x6148		Span Start – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
	0x02	Temperature Value	4	REAL32
0x6149		Span End – FP		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	4	REAL32
	0x02	Temperature Value	4	REAL32
0x6150		Status		
	0x00	Number of Entries	1	UNSIGNED8
	0x01	Pressure Value	1	UNSIGNED8
	0x02	Temperature Value	1	UNSIGNED8

0x6148 / 0x6150

Table A-1 (Part B): Object Dictionary – Values

Index	Sub-Index	Read / Write	Default value	Result + Data (If applicable)
0x6148				
	0x00	R	2	
	0x01	RW	0	Local pressure limit (minimum)
	0x02	RW	0	Local temperature limit (minimum)
0x6149				
	0x00	R	2	
	0x01	RW	0	Local pressure limit (maximum)
	0x02	RW	0	Local temperature limit (maximum)
0x6150				
	0x00	R	2	
	0x01	R	0x00	Status: Local limits (Pressure)
	0x02	R	0x00	Status: Local limits (Temperature)

Appendix B

Data for the alternative pressure units

The basic operation of the pressure transducer uses mbar for the pressure calculations. Druck uses the 'Ordering Information' that you supply to set the default units for the pressure output. The default units are: mbar, bar, or psi.

Table B-1 supplies the values you can use to get an output in one of the alternative pressure units.

Table B-1: (Part of table) Values to get alternative pressure units

Pressure units		CANopen value (Units) (Object: 0x6131 01)	Scale-factor (Object: 0x6123 01)
mbar	millibar	0xFD4E0000	1
bar	bar	0x004E0000	0.001
Pa (N/m2)	pascal (newton per square metre)	0x00220000	100
hPa	hectopascal	0x02220000	1
kPa	kilopascal	0x03220000	0.1
Mpa	Megapascal	0x06220000	0.0001
mmHg	millimetre of mercury	0x00A00000 (Note)	0.7500616
cmHg	centimetre of mercury	0x00A00000 (Note)	0.07500616
mHg	metre of mercury	0x00A00000 (Note)	0.0007500616
inHg	inch of mercury	0x00A00000 (Note)	0.02953
kg/cm2	kilogram-force per square centimetre	0x00A00000 (Note)	0.001019716
kg/m2	kilogram-force per square metre	0x00A00000 (Note)	10.19716
mmH20	millimetre of water	0x00A00000 (Note)	10.19716
cmH20	centimetre of water	0x00A00000 (Note)	1.019716
mH20	metre of water	0x00A00000 (Note)	0.01019716
torr	torr	0x00A00000 (Note)	0.7500616

Table B-1: (Part of table) Values to get alternative pressure units

Pressure units		CANopen value (Units) (Object: 0x6131 01)	Scale-factor (Object: 0x6123 01)
atm	atmosphere	0x00A00000 (Note)	0.000986923
psi	pound-force per square inch	0x00A00000 (Note)	0.01450377
lb/ft2	pound-force per square foot	0x00A00000 (Note)	2.088543
inH20 4°C	inch of water at 4 °C	0x00A00000 (Note)	0.4001775
inH20 60°F	inch of water at 60 °F	0x00A00000 (Note)	0.4021858
ftH20 4°C	foot of water at 4 °C	0x00A00000 (Note)	0.03345526
ftH20 60°F	foot of water at 60 °F	0x00A00000 (Note)	0.03351545

Note:

The CANopen value 0x00A00000 shows that the pressure unit is not an SI unit (refer to References - DRP-303-2).

If other units are necessary, set the applicable values to agree with your local conditions.